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Forum Article

Focused on farmers: On the irreplaceable role of man and his animals in biodiversity conservation

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Abstract: The need to consider land-use history when protecting habitats in cultural landscapes has been documented frequently in the scientific literature. However, after the extinction of traditional rural cultures, the nature conservation praxis faces the difficult task of finding appropriate but practicable and economical analogues of extinct agricultural practices. The aim of this forum article is to provoke a debate on biodiversity conservation in a cultural landscape and the sustainable management of dry calcareous grasslands. We present the complexity of this issue using an example from the Hainburger Berge Mountains in north-eastern Austria, a Natura 2000 site rich in dry grasslands. We then go on to discuss desirable directions for future European agricultural developments. In this area, traditional farming was already abandoned by the mid-20th century. Due to the high conservation value of the area, nature conservationists developed a restoration plan in the 1980s. Since then, re-introduction of sheep grazing by pioneer farmers Elisabeth and Erich Zillner is contributing to maintaining local biodiversity. On the Slovak side of the Danube River, in the Devínska Kobyla National Nature Reserve, re-introduction of grazing to valuable dry grassland habitats only started in 2012. In our story focused on a farmer's perspective, we would like to demonstrate that grassland farming is never independent from food production and people's way of life. Personal interviews with farmers and employees of conservation institutions helped to clarify different perspectives and allowed us to see things in a new light. We consider that development of local markets together with product-based subsidies, taking into account local conditions, are the most efficient way to support sustainable farming practices and biodiversity.

Keywords: biodiversity; Devínska Kobyla; dry grassland; family farm; goat; Hainburger Berge; history; Hundsheim; NATURA 2000; sheep; subsidy.

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Fig. 1. The Hainburger Berge Mountains are situated at a junction of the Alps, the Carpathians and the Pannonian Basin. View from Braunsberg to Hainburg, Hundsheimer Berg and Schloßberg. Photo: M. Janišová.



Fig. 2. Hundsheim village, situated at the foothill of Hundsheimer Berg, was first mentioned in historical documents in 1123. Photo: M. Janišová.

Introduction

Over the last few decades, a rapid decline in terrestrial insect biomass has been observed in Central Europe, even in nature-protected areas (Hallmann et al. 2017; van Klink et al. 2020). The rural landscapes of Europe have been fragmented and homogenized (Jongman 2020) and biotic homogenization across various taxonomic groups and a wide range of ecosystems has resulted in significant ecological, evolutionary and social consequences (Olden et al. 2016). Another phenomenon of our modern western civilization is an increased unification of human nourishment. Although we can easily buy tropical fruits all year round, basic foodstuff is standardised: the milk is pasteurized and usually has 3.6% fat content, but with the same poor taste from Rotterdam to Sofia, despite being sold in so many different packs on a single supermarket shelf. Are these facts connected? Or even more dreadful: are the aforementioned drastic declines and unifications consequences of the integrated developments in European agriculture?

The transition from traditional low-input agricultural production to a highly mechanized high-input one, and the industrial agronomy with the main objective of reducing manpower and costs of production have driven us into a cul-de-sac. Here we do not discuss the issue as to whether or not the foodstuff should be produced with the lowest costs possible. Rather, in this article, we intend to focus on the effects of social, political and economic development on landscape and biological diversity. We also would like to question whether the recent direction is correct and necessary. Our countryside has been simplified, homogenized and has lost its liveliness in many places. The animals, that were formerly grazing grasslands during the warmer seasons of the year are now kept in stables and fed with fodder that is produced from arable fields, and, in some cases even on other continents. Turning back the clock is impossible, but a

return to the knowledge of our ancestors is necessary. Not surprisingly, interest in traditions and history has grown enormously in recent years. What we have previously left with such ease as being something obsolete, insufficient and unsatisfactory, we now see in a different light. We will return life and diversity to our countryside only if we change the cost-based approach. Today we can still decide what we will eat tomorrow. NOW is the time to re-evaluate our position.

Let's look at the history of a beautiful area in the southwestern tip of the Carpathians; the Hainburger Berge in Austria and the Devín Carpathians in Slovakia. Let's consider whether we have a chance to preserve the natural values of this extraordinary region. Let's find a way out of the cul-de-sac!

Hainburger Berge – a biodiversity hotspot on a crossroads

The Hainburger Berge mountain range (Fig. 1) is located south of the Danube River in Lower Austria and Burgenland (centre at 48.12° N and 16.98° E), only 50 km east of Vienna, the capital of Austria. It is the southern-most part of the Devín Carpathians and the only part of the Carpathian Mountains in Austria. The mountain range, covering only 36 km², is dominated by three hills – Hundsheimer Berg (481 m), Braunsberg (346 m) and Spitzerberg (306 m). These hills represent the last “islands” of larger well-maintained grasslands in the region.

Thanks to its location on a crossroads of human and natural migration routes, on the border of the Alps, the Carpathians and the Pannonian Basin, and also due to a stable and mild climate plus thousands of years of human activity, an enormous diversity of flora and fauna has accumulated in this region (Pokorný & Strudl 1986; Waitzbauer 1990; Englisch & Jakubowsky 2001; Rötzer 2009). The rarest plant species are

dry grassland specialists such as *Dracocephalum austriacum*, *Stipa pulcherrima*, *Ranunculus illyricus* and *Adonis vernalis* (all included in the Austrian Red List, see Niklfeld & Schratt-Ehrendorfer 1999 and Anonymus s. d.). They still survive in grasslands on the hills outside the settlements and intensively managed agricultural habitats. The dry grassland habitats are also the habitat for a variety of invertebrates, e.g., over 1,315 butterfly and moth species, which represent one third of the Austrian *Lepidoptera* species pool. In 1965 Braunsberg and Hundsheimer Berg were declared as nature reserves with Spitzerberg following in 1981. In 1989, the European Council listed the three sites as biogenetic reserves and later the whole area became a NATURA 2000 reserve with the name “Hundsheimer Berge”. In the territory covering 2,140 ha, ten habitats and six species of European importance occur (Rötzer 2009).

Dramatic changes in agriculture over the last 250 years

As with many areas in the east of Austria, the grasslands of Hainburger Berge were mainly used for sheep grazing in the 18th and early 19th century. Large areas were grazed by sheep, e.g., in 1830, 800 sheep were kept in Hundsheim (Fig. 2), 900 in Bad Deutsch-Altenburg, and 1,010 in Prellenkirchen. Pastures were not only be found on the mountains, but also in wet areas along rivers and near villages. Since then, the pasture area has declined from about 10,000 ha to 111 ha in 2010 (Fig. 3). At the beginning of the 20th century, sheep were gradually replaced by cattle. Grazing came to an end in the 1960's with local farmers changing to pig breeding (Fig. 4). By then, all grasslands in the flat areas had been converted into arable land.

Since 1995, subsidies for the use of high nature value grasslands have been available, but later, the relevant area and, therefore, the sum of subsidies per year was progressively reduced by the authorities, as only grasslands with a set level of agricultural productivity were eligible for subsidies rather than shrublands or rocky areas. Since 2000, nearly all the farms in Hundsheim and the surrounding areas ceased animal husbandry almost completely and concentrated instead on arable farming or wine production. The number of people working in agriculture in Hundsheim continually declined throughout the 20th century from almost 400 in 1934 to only 13 in 2011, resulting ultimately in only 2% of the economically active population (Fig. 3).

Searching the conservation strategy

In the 1970's and 1980's, the Hainburger Berge were studied intensively by botanists and zoologists, and the results confirmed the unique biodiversity of the area and its high importance for nature conservation. A study by the entomologist Wolfgang Waitzbauer (published in 1990) was of especial importance as he proposed a new grazing schedule according to a complex set of rules and a conservation grazing scheme. By chance, two people:

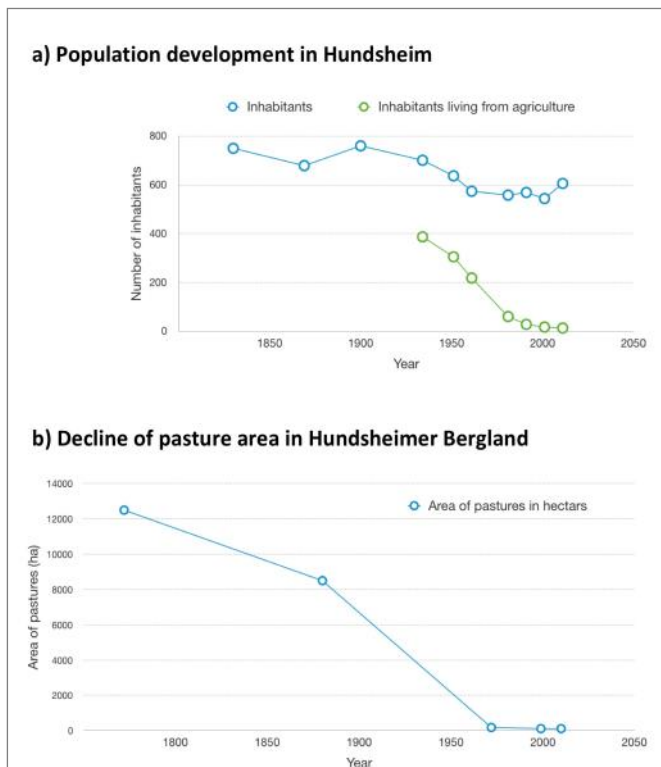


Fig. 3. Hundsheim demography and pasture area. a) Rapid decline in number of people living from agriculture since the beginning of the 20th century (values for the following years are available: 1830, 1869, 1900, 1934, 1951, 1961, 1981, 1991, 2001, 2011). This is a general trend in Central Europe reflecting technological developments and agricultural intensification. These data for the Hundsheim village represent the trends in lowland areas with productive soils at the periphery of the Carpathian Mountains. At higher elevations in the Carpathian upland the decline began later and was region-specific. b) The decline of pasture area in Hundsheim and surrounding area (Hundsheimer Bergland) since the 18th century (values for 1772, 1880, 1972, 1999, 2010) is related to changes in animal husbandry. Sources: Schweikhardt (1832), Waitzbauer (1990), Statistik Austria: Agrarstrukturhebung (Gemeinde Hundsheim).

Elisabeth and Erich Zillner (originally employed as a secretary and journalist, respectively) were willing to implement this system.

The grazing scheme initiated by the Zillner family started in 1983 after a lengthy period of grassland abandonment (the last-abandoned sites were grazed until 1964, but most sites were abandoned before 1950 due to the very low number of remaining animals (Fig. 5). The Zillners commenced with a “sheep-credit” from the Vienna municipality, with grazing starting at Bisamberg and Cobenzl on the Vienna outskirts. During the optimum period they had 250 ewes, supported by the subsidies over 10-years, but afterwards the area of subsidised grassland was reduced by 30% due to a large

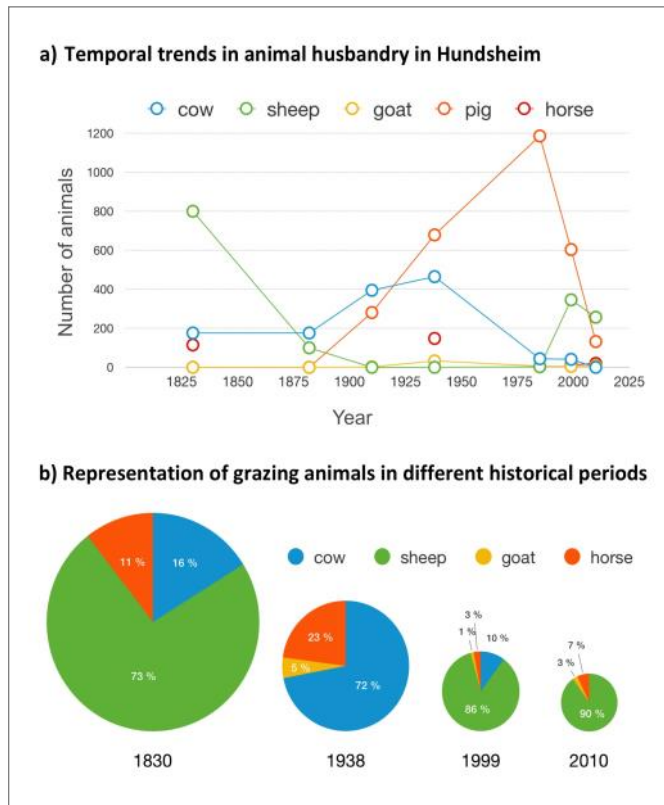


Fig. 4. Trends in animal husbandry in the Hundsheim village since 1825. a) The decreasing numbers of all domestic animals since the 1980's had one exception – the start of sheep breeding by the Zillner family in 1983. Also, after 2010, goat and horse breeding increased, but precise data are not available. Values for following years are shown: 1830, 1882, 1910, 1938, 1985, 1999, 2010. b) Differences in the representation of domestic grazing animals in the Hundsheim village (pigs are not included) in four different years. The size of the pie charts is proportional to the total number of livestock in the village in the particular year. Sources: Schweickhardt (1832), Statistik Austria: Agrarstrukturhebung (Gemeinde Hundsheim), Österreichisches statistisches Landesamt (1939), Österreichisches statistisches Zentralamt: Viehzählungen (1939), Morent (1987).

proportion of rocky slopes. As a consequence, the Zillners had to reduce the number of ewes to 120–150. The grazing intensity with 250 animals was confirmed as optimal also by monitoring. The monitoring was undertaken between 2004–2008 by Thorsten English (V-P-N Büro für Vegetationsmonitoring-Populationsökologie-Naturschutzforschung, Vienna, Austria) and three regimes were compared: ungrazed (control), half-intensity grazing, full-intensity grazing. The results were the same for all plant and animal groups except for a particular group of *Hymenoptera*, including wasps, bees and ants, which are unable to move with their nests over larger distances and therefore survive best in ungrazed plots.

Recently, the most important farm products are lamb meat and woollen products. Sheep milk is not produced, as the

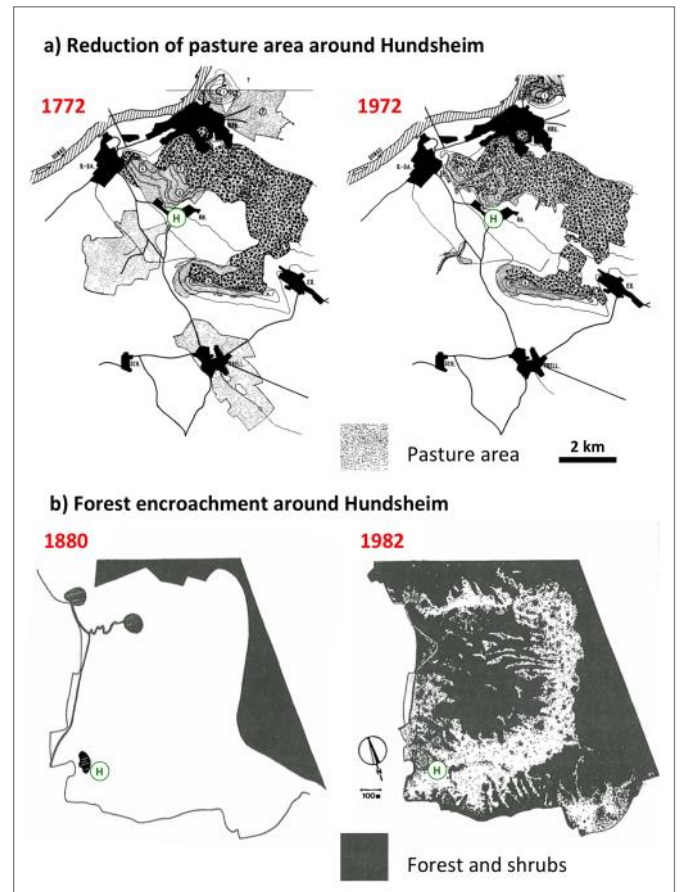


Fig. 5. a) During two centuries (1772–1972) the pasture area around Hundsheim (green H in the maps) has been significantly reduced. b) Over a c. 100-year period (1880–1982) most of the pasture area on the Hundsheimer Berg became overgrown by shrubs and trees. Source: Waitzbauer (1990).

sheep varieties they use are unsuitable for this purpose, especially when sheep are kept on dry grassland habitats, where the livestock trail is long, and the altitudinal difference is high. In the beginning, the animals had to move from the barn near the village to the pastures on the hill and back down to stable each day as there was no water in the grazing area. Later, a forest road was built which could be used for water transport.

Besides the will and knowledge, a proper flock is needed

The original sheep breed of the region, the “Pressburger Steinschaf” had long since disappeared. It was a local breed of the Steinschaf that had previously occurred across the entire Austrian and Bavarian Alpine areas.

The current mixture of sheep varieties at the Zillners farm originates from Tiroler Bergschaf and Juraschaf. Later crosses with Merino Landrasse improved the wool products due to the more delicate hair of the Merino that does not pierce the quilt (Fig. 6a,b). The Zillner family farm is one of the very few farms in east Austria where wool forms part of their economic base.



Fig. 6. Sheep breeding by the Zillner family. a) Mixing the flock with Tiroler Bergschaf, Juraschaf and Merino-Landschaf created a type of sheep that is perfectly adapted for the area, and they look just like the sheep that were kept here 70 years ago. b) The mixed flock composed of sheep and several goats is ideal for dry grasslands. The animals are efficient in eliminating shrubs and young trees and prevent forest succession. The current flock size is not sufficient to keep all the grasslands open. Twice as many animals are considered optimal for this site. However, sheep numbers are limited by the farm economy. c,d) The electric fences are supported by solar energy and shifted every 1–2 days to another parcel. Photos: M. Janišová.

Erich Zillner's comments about the sheep breed:

"Mixing the flock with Tiroler Bergschaf, Juraschaf and Merino-Landschaf created a type of sheep, that is perfectly adapted for the area, and, as we got to know afterwards, in a funny way it looks just like the sheep that were kept here 70 years ago, approximately from 1940 to 1950."

Formerly, all the sheep suffered from a copper deficiency. The animals were weak and had problems with muscle tone. At that time, it was difficult to identify the reason, as this is not a common problem in Austria (<https://www.agric.wa.gov.au/feeding-nutrition/copper-deficiency-sheep-and-cattle>). The Zillners introduced a salt lick containing copper and the situation improved. In the past, the local sheep used in dry grasslands might have been adapted for copper-poor nourishment, but adaptation is a lengthy process. In addition, the animals at that time were fed by nutrient-rich hay (and probably also willow branches) from alluvial meadows in winter, which is not the case today.

Grazing practices of the Zillner family

Following the recommendations of Waitzbauer, the pastures on Hundsheimer Berg of about 30 ha were divided into electrically fenced parcels ranging between 0.5 and 2.0 ha. The area was restricted by the wire length and battery capacity. The voltage has to be quite high due to the insulation of sheep wool. As a consequence, Haflinger horses transported the heavy batteries. More recently the Zillners introduced solar panels (Fig. 6c,d).

The sheep flock grazes each parcel for only one or two days and only once during the year. The grazing intensity is thus regulated by parcel size. Each parcel is grazed at different periods during different years, as the grazing is rotated annually including another part of the area. Grazing commences usually at the end of March or the beginning of April and ends in late October or the beginning of November. In the winter period (120–150 days), the sheep remain stabled in the foothills.

One sheep consumes 2 kg of hay or 5 kg of green fodder per day. Shearing is possible twice per year, but according to the Zillners, the optimum frequency consists of three cuts in two years. The wool is used to produce woollen products (flowers, pillows, blankets, toys, table linen) directly at the farm following processing in Belgium.

Sheep breeding – a risky business

As with every enterprise, sheep breeding has its own limits and risks. Recent income of the Zillner family farm consists of three main sources: 50% subsidies, 25% lamb meat, and 25% wool products. Three main factors influence farm prosperity:

- The subsidies for grassland management in the rocky areas have been reduced in the past as the Austrian agro-

policy supports mainly high production farming. Thus, the family income from subsidies has decreased by about 30%. Moreover, grass production of dry grasslands depends heavily on weather conditions and may be insufficient in years with little precipitation. Therefore, a large buffer area is necessary. However, the management of this buffer area is problematic where conservation subsidies are concerned.

- A statutory check of parasites by a veterinary specialist formerly cost 6–8 Euros per lamb. Following the retirement of the veterinarian in Hainburg, another veterinarian has to come from Fischamed (30 km away from Hundsheim), so that the costs increased up to 25 Euros per lamb due to increased distance and the reduced number of lambs. Moreover, each lamb has to be checked twice - first during a check of the husbandry conditions, and then



Fig. 7. Goat breeding by the Zillner family. a) Goat pasture at the foothill of the Hundsheimer Berg. b) Milking goats using a mobile milking device. c) Goat cheese production. d) The daily milk production of 50 litres can be transformed into 5–6 kg of delicious cheese. Photos: M. Janišová.

again when slaughtered to inspect the carcass for endoparasites. Recently, the high veterinary costs have become one of the most important limiting factors for the family farm.

- Recently, a lack of hay for the winter months has also limited farm development and is a consequence of the increase in arable farming in the region. At the beginning, the Zillners rented 40 ha of alluvial meadows near Marchegg to make hay (400 of 300-kg bales) for their 200 ewes at that time. Later, the landowner, World Wildlife Fund started to use parts of the area as a semi-wild pasture and rented the rest. There was insufficient sources of hay in the vicinity and the transport from remote areas was expensive. The price of hay in the period 2017–2018 was 14–18 cents per kg. As a consequence, the Zillners were forced to reduce the stock numbers. A solution would be a bio farm with rotation on arable fields including alfalfa mown three times per year with the last mowing being the best nutritional quality for sheep.

Future visions for farm development

In spite of unfavorable economic conditions, the farming activities of the Zillner family are increasing. Since 2015, the next generation – Emanuel Zillner and Ilse Gumprecht – have established a goat farm (Fig. 7a,b) to produce three types of goat cheese for the local market: with Schabzigerklee (*Trigonella caerulea*), with herbs and with spices (7c,d). They also sell yoghurt and fresh milk directly at the farm gate, at markets in Hainburg and Bruck an der Leitha, at specialist outlets in Vienna and by delivery.

They keep a mixed race from Steiersche Scheckenziege, Toggenburger and Burenziege (with hanging ears in some animals). The goats graze the lower parts of the grazing area in order that they are accessible for milking twice a day using a mobile milking device. Goats that are too immature to be milked, can also be grazed on remote pastures on the Königswarte in the eastern part of Hainburger Berge.

Why is the story about Hainburger Berge so important?

The answer is included in a strong statement of Thorsten Englisch: “For me there are two points, which make the story interesting: the first is the high biodiversity here, where the animals, the habitats, are already the hotspots for Austria. The species numbers that you find here, wherever you look, for groups of animals or plants are quite extraordinary. In addition, the habitats are very diverse and interlocking. That is the natural condition. The other is that now you have a person who manages this for 35 years in a way and cares the whole thing that you could never pay, the two people who exploited themselves to achieve the project goal [given by Waitzbauer] (to move because they liked the area itself so much, and because they wanted to do something that contradicted the usual working thought and the consumer world).” (Fig. 8).

On the other side of the Danube River

Similar dry grasslands on the northern banks of the Danube River (the massive of Devínska Kobyla, the Thebener Kogel, in Slovakia) have had a different developmental history since 1918, when the Habsburg monarchy collapsed. Also, the Slovak nature conservationists are aware of the extraordinary nature value of the Devínska Kobyla and the National Nature Reserve was established in 1964. Within its area of 101 km², more than 1,100 vascular plant species have been recorded, 82 of them protected by the state (Feráková & Kocianová 1997).

Grazing ceased on the territory of Devínska Kobyla after 1949. In the years between 1950 and 1964, the area was included in the border zone inaccessible to the public. Since 1956, afforestation of grassland habitats started using native and also alien trees, such as *Pinus nigra* (Kaleta 1965; Feráková & Kocianová 1997). After declaring the nature reserve in 1964, all human activities were strictly banned, including grazing, mowing and elimination of woody plants. This initiated undesirable changes in local flora and vegetation (Feráková & Kocianová 1997). Between 1949 and 2011, the grassland area in the nature reserve declined from 85.8% to 38.9% (Hegedúšová & Senko 2011). The reserve became overgrown by shrubs and trees, many of which were invasive exotics.

Thanks to the efforts of the non-governmental organization BROZ (Regional Association for Nature Conservation and Sustainable Development), grazing has been reintroduced to some of the remaining 38 ha of grasslands after a 50-year period without grazing (Fig. 9). In 2012, the organization initiated a LIFE project on “Restoration of NATURA 2000 sites in cross-border Bratislava capital region”.

Andrej Devečka, the ecologist from the BROZ, informed us about their LIFE project in April 2018:

“We started in 2013 with a flock of 35 goats (Slovak white goat), and it was not easy to buy the goats for the project. In 2017 we had 80–90 goats in two flocks, in 2018 we will keep 105 goats including young animals. We decided on goats because the grasslands are strongly overgrown by shrubs. Another reason was that a young farmer available for the project also preferred goats. He milked them and used half for milk, half for cheese production. The first shepherd recently left for a more manageable site. We have problems in finding a new shepherd. The LIFE project is now over, from now on we will use only the subsidies to cover the costs, only one flock, no milking and no young animals.”

Expert opinion differs as to what should be done to rescue the valuable dry grassland remnants. The animal farming close to the Slovak capital is not accepted positively by everybody. It is not only about the animal smell and their excrements; people are sometimes shocked by seeing the trampling and disturbance caused by the goat flock. The period when the site was grazed by hundreds of animals (sheep, goats, cattle and horses) is long forgotten. Or maybe some people remember the strong overgrazing by sheep flocks



Fig. 8. Flowering *Adonis vernalis*. Diverse dry grasslands are rich in rare and endangered species such as this species and are a reward for proper grassland management. Spitzerberg in May 2018. Photo: M. Janišová.

An educational panel with the title "Úloha pastvy v chránených územiach" (The role of grazing in protected areas) and its German translation "Die Rolle von Beweidung in geschützten Gebieten". The panel features a central image of a goat and is surrounded by various smaller images of plants and insects. It contains text in three languages: Slovak, German, and English. The English text includes sections like "The type of grazing", "The main advantages of grazing for protected areas", and "Diverse grasslands are a reward for proper grassland management". The bottom left corner has the BRQZ logo and contact information for the Regional Association for Nature Conservation and Sustainable Development.

Fig. 9. The importance of grazing reintroduction to the National Nature Reserve Devínska Kobyla is clearly communicated to the site visitors through a set of educational panels and instruction leaflets. Photo: M. Janišová.

during the 1950's mentioned by Klement Ptačovský, the Czech botanist (Ptačovský 1959): "The botanical conditions are not the same on both sides of the Danube, the Austrian side is more affected by the Pannonian Basin and has more thermophilous elements which do not occur on Devínska Kobyla. But the vegetation on both Danube sides is very similar. Significant part of the orchards was and still is transformed to vineyards and fields (also some stony slopes with a shallow humus layer, which are evidently not suitable for such purpose). The orchards, meadows and rocky slopes above the Morava River are grazed by such a huge flock of sheep, that there are bare sites without vegetation, or only dry nibbled stalks can be found in some places. The whole slope is endangered by the moving flock (erosion). Many of the transformed and destroyed gardens were localities of the rarest species, especially orchids. Some of the slopes are afforested by alien or native trees. Moreover, the quarry and sandpit are expanded. But the most damage is caused surely by the sheep."

The Slovaks do not have their Zillners, but also not their Waitzbauer. However, the National Nature Reserve and NATURA 2000 site Devínska Kobyla has entered a new stage in its development. The activities in the recent LIFE project evidently improved the situation: the shrubs were reduced, invasive trees were eliminated and the dry grassland species gradually recover.

Conclusion

Finally, the political situation (and the former political, military, and ideological barrier between the "West" in Austria and the "East" in Slovakia) was not a decisive factor for the fate of dry grasslands at the Carpathian-Pannonian crossroads. The change in the way of life has won on both sides of the Iron Curtain, just as it has overcome barriers between continents. It has changed the landscape out of all recognition on both sides of the Danube River. In spite of that, species-rich grasslands can be maintained. There are some people almost everywhere who show us how it can be achieved. Grassland conservation is not about simulating history, maintaining some structures of bygone times and adherence to the disappearing traditions. It is more about people finding a new way of life and new forms of regional high-quality food production. It is clear that the only way to generate a positive contribution to profits is self-marketing of the high-quality products. But nevertheless, a subsidy system that discriminates against agronomic systems that are adapted to the natural environment contrary to intensive farming is highly inequitable. Europe cannot afford to lose completely a branch of agronomy that combines the production of high-quality and healthy food with maintaining landscapes of high nature value.

Author contributions

M.J. planned the research and led the writing, M.M. developed the introduction and the conclusion, H.R. contributed the population and agricultural statistics of the Hainburg area while all authors participated in the interviews and critically revised the manuscript.

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